

REMARKS

This Preliminary Amendment and the After Final Amendment filed on April 3, 2007, constitute the proper Submission with the RCE being concurrently filed and fully complies with M.P.E.P. § 706.07(h)(II). Applicants additionally note that the Advisory Action of April 24, 2007, states that the April 3rd Amendment requires further consideration and search by the Examiner (see page 2 of “Continuation of I1”).

Also, a Petition for Extension of Time is being concurrently filed with this Preliminary Amendment. Thus, this Preliminary Amendment is being timely filed.

Applicants respectfully request the Examiner to reconsider the present application in view of the foregoing amendments to the claims and the following remarks.

Status of the Claims

In the present response, claims 19-33 are being amended and claims 38-43 are being added. Further, claims 1-13 and 34 were previously canceled without prejudice or disclaimer of the subject matter contained therein. In addition, claims 14-17 are withdrawn from consideration. Thus, claims 14-33 and 37-43 are pending in the present application.

No new matter has been added by way of these amendments because each amendment is supported by the present specification and/or is editorial in nature. For example, the amendment to claim 1 replaces “plasticizing agent” with “plasticizer.” The term “plasticizer” is used throughout the present specification, such as paragraph [0021] of the publication of this application (US 2002/0043316 A1). Similar minor amendments are made throughout the other

pending claims. Thus, these are clarifying amendments that are not narrowing in scope. By deleting/amending these terms in order to clarify the claimed invention (e.g., "A" to "The"), Applicants are in no way conceding any limitations with respect to the interpretation of the claims under the Doctrine of Equivalents.

No new matter has been added with new claims 38-43. These claims are added as being directed to other embodiments of the invention and for the Examiner's consideration. New claims 38 and 39 are directed to more specific embodiments of claim 19 (see steps a) and b) of claim 19). Support for new claim 40 is found throughout the present specification, as well as pending claims 19, 23 and 32. New claims 41-43 have support in pending claims 26 and 30.

Based upon the above considerations, entry of the present amendment is respectfully requested.

In view of the following remarks, Applicants respectfully request that the Examiner withdraw all rejections and allow the currently pending claims.

Issues under 35 U.S.C. § 112, Second Paragraph

Claim 34 stands stand rejected under 35 U.S.C. § 112, second paragraph, for asserted lack of definiteness (see paragraphs 2-3 of the outstanding Office Action). This claim was canceled in the April 3rd Amendment, thus rendering this rejection moot. Withdrawal of this rejection is respectfully requested.

Issues under 35 U.S.C. § 112, First Paragraph

Claims 19-37 stand rejected under 35 U.S.C. § 112, first paragraph, for asserted lack of enablement (see paragraphs 1 and 4 of the Office Action). Applicants respectfully traverse, and reconsideration and withdrawal of this rejection are respectfully requested.

First, Applicants respectfully submit that a specification disclosure which contains a teaching of the manner and process of making and using an invention in terms which correspond in scope to those used in describing and defining the subject matter sought to be patented must be taken in compliance with the enablement requirement of 35 U.S.C. § 112, first paragraph, unless there is a reason to doubt the objective truth of these statements. *See In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971); M.P.E.P. § 2164.04. Here, Applicants respectfully maintain their position as stated in the April 3rd Amendment, wherein the present specification and the information known in the relevant art readily enables one of skill in the art to make and use the present invention.

For the Examiner's convenience, Applicants herein enclose excerpts from some of the publication cited in the April 3rd Amendment. In particular, Applicants respectfully refer the Examiner to page 5, lines 1-7, and page 5, line 16 to page 6, line 3 of Canadian Patent No. CA 02298513 that describes polymeric desensitizers. Page 5, lines 1-2 of CA '513 even describes how "desensitizers" include "inert or energetic polymers." Further, column 4, lines 12-13 of U.S. Patent No. 5,043,031 describes how binders having a "desensitizing effect" include thermoplastic polymers. Finally, column 3, lines 1-4 of U.S. Patent No. 6,042,663 describes how polyester polyols can be added to "desensitize" energetic plasticizers. Regarding these

publications, there is no requirement for the present specification to disclose every possible enablement if there is sufficient guidance given by knowledge in the art, such as that well-known to those skilled in the art. M.P.E.P. § 2164.05.

Second, Applicants respectfully note that the breadth of a claim is not to be equated with indefiniteness. *In re Miller*, 441 F.2d 689, 169 USPQ 597 (CCPA 1971); *see also* M.P.E.P. § 2173.04. As mentioned, one of skill in the art understands the meaning of a “polymeric desensitizer,” and also can make and use the present invention without undue experimentation. Applicants also note that “The initial burden of establishing a *prima facie* basis to deny patentability to a claimed invention on any ground is always upon the examiner.” *Ex parte Parks*, 30 USPQ2d 1234, 1236 (citing *In re Oetiker*, 24 USPQ2d 1443 (Fed. Cir. 1992)); *see also In re Piasecki*, 745 F.2d 1468, 223 USPQ 785 (Fed. Cir. 1984). The burden has not been shifted to Applicants, as no scientific or technical evidence has been provided to show that the claimed “polymeric desensitizer” is not enabled.

Thus, reconsideration and withdrawal of this rejection are respectfully requested.

Issues under 35 U.S.C. § 102(b)

Claims 19-37 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Coffee *et al.* ‘916 (U.S. Patent No. 3,108,916) (see paragraphs 5-6 of the Office Action). Applicants respectfully traverse and reconsideration is based on the following remarks.

As previously stated (see, e.g., the April 3rd response at pages 12-13; *see also* the Pre-Appeal Brief dated April 30, 2007 at pages 3-4), Applicants respectfully maintain that Coffee

'916 fails to disclose all claimed features, especially instantly claimed step d) of pending claim 1. Specifically, step d) of the claimed invention recites "diffusing at least one emulsion . . . into the receptive grain . . .". In contrast, Coffee '916 discloses its "di-esters . . . do not penetrate the surface of the grains" and only a "molecular external coating" is formed on the surface (at column 2, lines 10-15).

Further, Coffee '916 is directed to a plastisol process, which differs from the present invention in several ways. Such differences are explained and conveniently summarized in the one-page attachment that was filed with the April 3rd response. For instance, Coffee '916 is not only is directed to coating the grain surface (instead of diffusing into the grain surface), this reference discloses a process that requires further processing of the formed grains (e.g., adding the plastisol solvent; adding energizer plus deterrent; heating; producing a homogeneous rigid body). In contrast, the present invention is directed to a method of forming grains with the energetic plasticizer and polymeric desensitizer in the grain surface. Applicants note other differences, such as the present invention using the energetic plasticizer or polymeric desensitizer in solution.

Accordingly, because "a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference," the cited Coffee '916 reference cannot be a basis for a rejection under § 102(b). *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Thus, because of the lack of disclosure of all features as instantly claimed, the rejection in view of Coffee '916 is overcome.

As mentioned, Coffee '916 fails to disclose the claimed feature of diffusing into the grain surface. But Applicants additionally note that the Examiner has not accounted for the features of the pending dependent claims. Instead, there appears to only be a discussion of the broader pending claim 19 in the outstanding Office Action. In this regard, Coffee '916 further fails to disclose the features of, e.g., instantly pending claim 25, which recites the "a diffusion depth of at least one of said energetic plasticizer or said polymeric desensitizer in the receptive grain is in the range of 100-500 μm ."

Reconsideration and withdrawal of this rejection are respectfully requested.

Request for Interview

Applicants respectfully request an Interview with the Examiner. Applicants also request that the Interview be conducted before issuance of the next USPTO correspondence (i.e., Office Action). Applicants' representative will be contacting the Examiner in about one month from the filing date of this response.

Conclusion

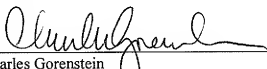
A full and complete response has been made to all issues as cited in the Office Action. Applicants have taken substantial steps in efforts to advance prosecution of the present application. Thus, Applicants respectfully request that a timely Notice of Allowance issue for the present case.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Eugene T. Perez (Reg. No. 48,501) at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Attachments: Pages 4-6 of CA 02298513
Columns 3-4 of U.S. Patent No. 5,043,031
Columns 3-4 of U.S. Patent No. 6,042,663

(dibutyl phthalate), ureas (Centralit) or camphor are used as desensitizers.

An observed disadvantage of the above-mentioned desensitizers is that they reduce the energy content of the propellant, and effect a substantial loss in the performance as compared to the untreated powder. These substances also tend in part (especially phthalates, for example) to migrate into the propellant, and have a detrimental impact on its ballistic function.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide a propellant, and a method of producing the propellant, in which the maximum-pressure curve can easily be flattened in the temperature range for which the weapon is specified.

This object and others are met by a composition of matter comprising propellants for gun ammunition surface treated with at least one of inert or energetic polymers and energetic, monomer softeners.

The concept underlying the invention is to perform a surface treatment on conventional mono-, di- or tribasic powders using special desensitizers, namely only those that have little or no tendency to migrate.

The desensitizers of the invention include inert or energetic polymers or large-volume monomers that practically do not migrate at all, and energetic, monomolecular substances, or mixtures of the components, 5 that reduce the energy loss to a level that yields no perceptible decrease in performance capability during the firing of the weapon.

The surface treatment of the propellants can be accomplished by any known method of surface treatment. For 10 example, the surface treatment may be sprayed on, as a solution or an emulsion, in a treatment drum, particularly a rotating treatment drum, or an impregnation method may be performed, in which the propellant is incubated in the treatment solution or emulsion for a specified period of 15 time.

The following substances, used alone or as mixtures, have proven particularly advantageous for surface treatment:

- non-energetic polyesters, polyethers, polyurethanes, 20 polyureas, polybutadienes, polyamides, cellulose esters (such as cellulose acetate, cellulose acetobutyrate, cellulose propionate);

- energetic polymers (e.g., poly-3-nitratomethyl-3-methyl oxetane (poly-NMMO), polyglycidyl nitrate (poly-GLYN), and glycidylazide polymer (GAP));
- alkyl nitrate ethyl nitramines (e.g., methyl nitrate ethyl nitramine (methyl-NENA), ethyl nitrate ethyl nitramine (methyl-NENA), and butyl nitrate ethyl nitramine (methyl-NENA));
- dinitro diazaalkanes;
- nitric acid esters (e.g., diethylene glycol dinitrate);
- nitroglycerine, triethylene glycol dinitrate, butane triol trinitrate, and metriol trinitrate; and
- bis(2,2-dinitropropyl) acetal (BDNPA), bis(2,2-dinitropropyl) formal (BDNPF).

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BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 and 2 show the dependence of the maximum pressure and the muzzle velocity on the ambient temperature of a first propellant, with and without the surface treatment according to the invention.

Examples of monomers which are converted to polymer propellants according to the Ullmann reaction are styphnine acid dichloride or 3,3'-dichlorohexanitrodiphenyl. The condensates such as, for example, polynitrophenyl and which are obtained by reaction with, for example, copper powder are oligomers with ca. 4 to 11 nitrophenyl component parts.

The polymer polynitroaromatic compounds usable as propellants form films in the case of use with solvents especially after mixing with plasticizers following evaporation of the solvent. They can be mixed as inert plasticizers with conventional plasticizers such as, for example, phthalic acid esters of alcohols C₁ to C₈, sebacic acid esters, adipic acid esters and glycol acid esters or camphor. Further, explosive plasticizers such as, for example, nitration products of benzene or toluene can, however, also be used for improvement of heat of explosion and oxygen value.

The use of high-temperature resistant polymer polynitroaromatic compounds as propellants with binder character takes place in the manner that they, preferentially dissolved in a solvent, are uniformly distributed in a kneader with the given well-known propellants or propellant-filler mixture. Accordingly, the mixed material is extruded and the extrusion obtained is cut into granulate. If necessary, the polymer polynitroaromatic compounds are used together with a well-known binding agent having a desensitizing effect and a plasticizer.

The distribution can, nevertheless, also be undertaken such that the solvent dissolving the binders and plasticizers is added during the kneading process to a mixture of propellant, binder and filler previously divided by screening.

The well-known propellants which can be mixed with the high-temperature resistant polymer polynitroaromatic compounds are more particularly such with decomposition points above 200° C. Propellant mixtures can also be used. Numbered, for example, among the usable propellants are the well-known organic nitro compounds used for this operational purpose and which are derived from mono- or polynuclear nitrated aromatic compounds. Such nitrated aromatic compounds are, for example, the di- and triamino compounds of symmetrical trinitrobenzene as well as their acylation products such as, for example, 2,4,6,2',4',6'-hexanitro-*N,N'*-diphenylurea.

It is also possible to use nitrated aromatic compounds which are connected with another by carbon atoms or by atoms of sulfur, oxygen or nitrogen.

Examples of this type of compound are nitration products of diphenyldiphenylamine, 3,3'-diaminodiphenyl, diphenyloxide, diphenylsulfide or diphenylsulfone or stilbene such as, for example, hexanitrodiphenyloxide, hexanitrodiphenylsulfide, hexanitrodiphenylamine as well as 3,3'-azo-bis-(2,4,6,2',4',6'-hexanitrodiphenyl).

Also belonging to the high-temperature resistant propellants which can be used are heterocycles containing picryl residues such as thiophene, 1,3-thiazole, s-triazine or pyrimidine and nitrated heterocycles such as 1,3,6,8-tetranitrocarbazole, 1,3,6,8-tetranitroacridone and, further, compounds such as tetranitro-2,3,5,6-dibenzo-1,3a,4,6a-tetraazapentalene.

Further, belonging here are also nitramines such as 1,3,5-trinitro-1,3,5-triazacyclohexane (cyclonite, RDX) and more particularly 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane (HMX) or nitric acid ester, for exam-

ple, on the basis of aromatic, heterocyclic or aliphatic nitro compounds such as, for example, 2,4,6,2',4',6'-hexanitrodiphenylaminoethyl nitrate or pentaerythritol tetranitrate.

HMX is preferred as a well-known propellant whereby it is possible by the use of polymer polynitroaromatic compounds in accordance with the invention to use additionally for reasons of safety a binder with desensitizing effect in the proportion of, for example, 5% and to achieve a solid binding of the mixture independently of the granular form of the propellant.

Suitable as additional binders with desensitizing effect are, for example, thermoplastic polymers such as, for example, polymers on the basis of acetalized polyvinyl alcohol whereby the acetalization is carried out with aldehydes having 1 to 6 C atoms and preferentially with butyraldehyde. Also suitable, however, are polyurethanes, polyesters, poly-(meth)-acrylate or cellulose esters.

Further, bifunctional monomers or reaction-capable oligomers or polymers can be used as desensitizing binding agents. During or after completion of the mixing with the propellant powder and the filler and the shaping, a radically performed crosslinkage or condensation can take place leading to a firm structure of the granular mixture.

The quantity of the additional binding agent having a desensitizing effect to be used is a function of the desired mechanical stability of the propellant compound and the contribution already performed for this purpose of the proportion of polymer polynitroaromatic compounds to be determined for thermodynamic reasons. The quantities of binding agents to be used are also a function of the type of distribution in the mixture of propellant and filler. If the distribution of the granulated substances takes place by screening the components, a lesser stability will also be achieved with higher shaping temperatures, for example molding temperatures, than when using the binders dissolved in a solvent. The relation of propellant to binding agent ranges in the latter case generally between 95:5 and 80:20.

The distribution of binding agents having a desensitizing effect in the propellant and, if necessary, the mixture of propellant and filler can be undertaken mechanically or preferentially by means of one of the solvents dissolving the binders. The use of a solvent dissolving the binders guarantees a uniform enclosure of the propellant and filler grain. The shaping and/or compression to solid propellant compounds follows the mixing process.

If polymer polynitroaromatic compounds are used as propellants with binder properties in accordance with the present invention, it follows that the weight ratio of the well-known propellants to the polymer polynitroaromatic compounds amounts to 99:1 to 50:50.

The manufacture of the shaped caseless propellant compounds generally takes place using the method whereby the powdered propellants with and without binder characteristic as well as, when necessary, independently well-known powdered fillers (for example, for porosity formation) and desensitizing binding agents are mixed by screening. The mixing can also take place with a fast-operating stirrer whereby one inert solvent such as, for example, gasoline or petroleum ether is appropriately used for each of the components in order to support the uniform distribution. In this case, the mixture is cleared of solvent after a successful uniform distribution, for example by filtering and subsequent

Polyester polyols can be added to an energetic plasticiser to desensitize it, and the desensitized plasticiser can then be stored for extensive periods prior to use in forming the composition.

The molecular weight of the polyol should be as high as possible subject to its solubility in the nitroglycerine. Polycaprolactones of molecular weight in the range 600-1250 may be used. For polyester polyols other than polycaprolactones, molecular weights in the range 1000-3000, and preferably 1000-2000, may be used.

The reaction should produce urethane linkages and may form both urethane and allophanate linkages.

Preferably both aliphatic and aromatic isocyanates are used. The preferred aliphatic isocyanate is trimethyl hexamethylene diisocyanate, but isophorone diisocyanate (a cycloaliphatic compound) is a possible alternative. The preferred aromatic isocyanate is diphenylmethane-4,4'-diisocyanate, and/or isomers thereof; toluene and xylene diisocyanates, and/or isomers thereof, are possible alternatives. There may be a mixture of aliphatic and aromatic isocyanates in the proportions 1:1 by weight. Preferably the isocyanate(s) have a slower reaction rate with water than with the selected polyol(s).

One or more catalysts may be employed to facilitate the required reaction. Suitable catalysts are di-butyl tin diacetate and ferric acetylacetonate, but alternative catalysts may be used. Preferably any catalyst employed facilitates urethane and allophanate reactions in preference to reactions between isocyanate(s) and water.

There may be a slight excess of isocyanate over that required for stoichiometric combination to form the additional polymer. The required excess depends upon the hydroxyl functionality of the nitrocellulose, which inevitably takes up some of the isocyanate. The required excess can be determined empirically; for the above compounds, an excess in the region 5-10% by weight of the isocyanate has been found suitable.

The isocyanate component could be added to the plasticiser as a desensitizer, but preferably this arrangement is not used because isocyanates tend to be volatile, and they will also tend to react with water to produce carbon dioxide which may also produce storage problems. Generally the polyol is used as a desensitizer and the isocyanate added just prior to casting.

Proportions (by weight) for a suitable casting liquid are as follows:

Nitroglycerine—60 to 89.8 parts, and preferably 70-80 parts

Polyol—5 to 32 parts, and preferably 7-22 parts

Isocyanate—up to 9 parts.

The amount of isocyanate required will depend upon the amount which reacts in use with the nitrocellulose, and the molecular weight of the reactants. The preferred reactants are diols and diisocyanates.

In any composition according to the invention, the additional polymer is preferably an elastomer having a glass transition temperature below -25° C.

In an alternative method and composition according to the invention, the polymer is based on a vinyl compound, preferably an acrylate. Preferred acrylates are derived from aliphatic alcohols, preferably alkanols. Alkyl acrylates having between two and eight carbon atoms in the alkyl group will form rubbers when polymerised. However, the glass transition temperature of the rubber increases as the number of carbon atoms in the alkyl group falls, giving poorer low temperature properties. Also miscibility with energetic plasticiser of a casting liquid falls as the number of carbon atoms

in the alkyl group increases. Further alkyl acrylates between butyl acrylate and octyl acrylate are not readily available. The preferred alkyl acrylate is therefore butyl acrylate, in its normal form or in an isomeric form. However, at least a proportion of ethyl hexyl acrylate, preferably 2-ethyl hexyl acrylate, may be used.

Butyl acrylate can be mixed with plasticiser such as nitroglycerine and the liquid can be stored. A free radical polymerisation initiator can be added immediately before use: such initiators include azo compounds especially azo bis-isobutyronitrile and peroxides especially lauryl peroxide. Preferably the initiator does not produce free radicals at temperatures substantially below the casting and/or cure temperature of the multiple base composition—say below 30° C. For this purpose, tertiary butyl cyclohexyl perdicarbonate is preferred.

In a further method in accordance with the invention, a mixture of a polyol and a hydroxy acrylate is reacted with an isocyanate to produce a mixed polymer including both the polyol and the acrylate. Simultaneously, a suitable catalyst can be included to cause polymerisation of the acrylate.

In yet a further method, a polyol pre-polymer is end capped with an isocyanate. In formation of the composition, the isocyanate end capping can be reacted with a polyol (diol or triol). The end capped pre-polymer can be added to the energetic plasticiser as a desensitizing agent. A suitable pre-polymer can be formed from the polyols discussed above, and a typical polyol for reaction therewith is 1,4 butane diol.

The proportion of rubbery polymer (elastomer) required in the composition will depend upon the elastomer, the service conditions for which composition is designed, and upon the other ingredients of the composition. Less than 2% by weight of any elastomer is unlikely to significantly improve low temperature properties. In compositions having low nitrocellulose contents, say below 25% by weight, elastomer contents of less than 3% by weight tend to give inadequate modulus at storage temperatures around 60° C. On the other hand, continued addition of elastomer may interfere with gelation of the nitrocellulose by the plasticiser and/or be achieved only by substitution for more energetic ingredients.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

By way of example, some specific compositions in their use as solid fuel rocket propellants in accordance with the invention will now be described in greater detail. Since existing propellant base grain casting techniques are used in each case, a brief description of such techniques will be given first and will be understood to apply to each example.

In these casting techniques, "base grains" comprising nitrocellulose, nitroglycerine and additives are produced to a carefully controlled formulation uniform throughout each grain. The additives may comprise each or any of fuel (for example metal particles), ballistic modifiers, burning rate stabilisers, oxidisers (for example perchlorates or nitramine); this list is not intended to be exclusive, since an advantage of the base grain casting system is that it offers possibilities for a wide range of formulations.

The base grains so formed are small relative to a rocket motor propellant charge, typical grains being 1 mm right cylinders. An appropriate number of them are located in a mould, and a casting liquid, the main ingredient of which is nitroglycerine as energetic plasticiser, is forced into the mould under carefully controlled conditions. The casting liquid is absorbed by the nitrocellulose to form a gel; the